## PROJECT FACT SHEET

**CONTRACT TITLE:** Minor and Trace Authigenic Components as Indicators of Pore Fluid Chemistry During Maturation and Migration of Hydrocarbons

**DATE REVIEWED:** 01/11/93 **DATE REVISED:** 06/26/92

**OBJECTIVE:** This project will evaluate authigenic sulfide minerals in conjunction with the mobility of uranium, as geochemical indicators of pore fluid evolution during hydrocarbon maturation and migration in the Smackover formation of the North Louisiana Salt Basin. The results of this research, integrated with conventional studies of carbonate minerals, will help define the diagenetic history of the Smackover.

**ID NUMBER:** DE-AC22-90BC14656

**B & R CODE:** AC1510100

**CONTRACT PERFORMANCE PERIOD:**
05/22/90 to 06/21/92
**PROGRAM:**
**RESEARCH AREA:**

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College Station, TX

**SCHEDULED MILESTONES:**

| | |
|---|---|
| Uranium and thorium isotopic concentrations and ratios determined | 11/91 |
| Sulfur isotope ratios determined | 11/91 |
| Isotopic patterns related to pore fluid evolution | 05/92 |

| FUNDING (1000'S) | DOE | OTHER | CONTRACTOR | TOTAL |
|---|---|---|---|---|
| PRIOR FISCAL YRS | 76 | 0 | 0 | **76** |
| FISCAL YR 1993 | 0 | 0 | 0 | **0** |
| FUTURE FUNDS | 0 | 0 | 0 | **0** |
| **TOTAL EST'D FUNDS** | **76** | **0** | **0** | **76** |

**PROJECT DESCRIPTION:** This project will characterize the authigenic minerals and chemical components directly related to hydrocarbon formation and test the hypothesis that they reflect the chemical evolution and migration pathways of pore fluids associated with maturation and migration of hydrocarbons. Specifically, the pore fluids related to late-stage diagenesis of the Smackover formation will be studied using uranium, thorium and sulfide abundances.

**PRESENT STATUS:** Project is complete.

**ACCOMPLISHMENTS:** This project has accomplished its goal of assessing the effectiveness of non-carbonate authigenic minerals and other chemical components as indicators of pore fluid evolution during hydrocarbon maturation and migration into carbonate reservoirs. It was found that late authigenic sulfur-bearing minerals provide information necessary to fill gaps in the diagenetic history of carbonate rocks. More research on the sorption behavior of uranium and the nature of the uranium-organic association is required before mobilization uranium can be used effectively as a diagenetic indicator.

1. Cd concentration in sphalerite, Ba concentration in celestite, and sulfur isotopic ratios of sphalerite and galena indicated that fluids associated with hydrocarbon migration moved up faults from the lower into the upper Smackover Formation. These parameters revealed that fluid flow along these faults was focused in a particular area.
2. Knowledge that fluid flow into the upper Smackover was focused in a particular area allows enhanced interpretation of previous researchers observations and data. The interpretations presented in this project may help to explain the distribution of major hydrocarbon fields producing from the Smackover.
3. A second generation of sulfide minerals, some of which had relatively heavy sulfur isotopic ratios, is consistent with the occurrence of large-scale thermochemical sulfate reduction after hydrocarbon migration. This supports the idea that thermochemical sulfate reduction is responsible for the "sour gas belt" in the upper Smackover of southern Arkansas.
4. It was demonstrated that even the small amount of clay minerals in limestones can control the behavior of uranium. Concentration of uranium correlated well with abundance of clay minerals in the Smackover limestones. This indicates that the abundance of sorption sites is the main factor controlling uranium concentration in these rocks. This has implications for environmental studies and the interpretation of spectral logs.
5. It was proposed that some geochemical process involving oxidation or reduction of sulfur had occurred at stylolites causing precipitation of sulfide minerals within and adjacent to these dissolution seams. Either $H_2S$ that flowed along stylolites was oxidized or abiologic reduction of sulfate was catalyzed by clay minerals in stylolites. This may have produced the $H_2S$ required to initiate larger-scale thermochemical sulfate reduction and may help to explain the porosity often observed along stylolites. In addition, this process should be considered in the interpretation of sulfur isotopic data from limestones.

**BACKGROUND:** During late-stage diagenesis as a portion of the sediment pile begins to enter the hydrocarbon generation window, the nature of basinal fluids changes dramatically. Time-temperature dependent reactions generate basinal fluids as well as play a critical role in changing pore fluid chemistry. Fluid-rock interactions intensify at this time. These inter-actions result in dissolution, authigenesis or both. Dissolution creates secondary porosity and permeability important to reservoir accumulations. On the other hand, authigenesis produces replacement and pore-filling minerals that significantly alter the reservoir's producibility. Although chemical and mineralogical analyses of carbonate and clay minerals have been valuable in interpreting diagenesis, limitations of these analyses make it highly desirable to develop alternative geochemical indicators.